

What is claimed is:

1. A function arithmetic method comprising:

a cyclic equation setting step transforming
5 and setting a Taylor series equation for
calculating a sine function into a single cyclic
equation common to terms of the Taylor series
equation, the single cyclic equation having a new
known number Q that is defined by multiplying a
10 known number Q and the square of a variable X ,
shifting the result by a shift number S and then
adding a constant K thereto;

an adjustment step adjusting and preparing
the shift number S such that within a variation
15 range of the variable X the variable X has a
maximum value 1 with the constant K being not
greater than 1; and

a cyclic equation executing step inputting
and converting angle information i to the variable
20 X , and executing the cyclic equation in sequence
from higher order term to lower order term for the
number of terms of the Taylor series equation to
derive a sine function of the angle information
1.

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2. The function arithmetic method according to
claim 1, wherein

the cyclic equation executing step includes executing the arithmetic process of the known number Q , the variable X , an intermediate value after the shifting and the constant K of the cyclic equation with the number of bits that is obtained by adding the number of protect bits to the final number of the bits.

3. A function arithmetic method comprising:
 10 a cyclic equation setting step transforming and setting a Taylor series equation for calculating a cosine function into a single cyclic equation common to terms of the Taylor series equation, the single cyclic equation having a new
 15 known number Q that is defined by multiplying a known number Q and the square of a variable X , shifting the result by a shift number S and then adding a constant K thereto;

an adjustment step adjusting and preparing
 20 the shift number S such that within a variation range of the variable X the variable X has a maximum value 1 with the constant K being not greater than 1; and

a cyclic equation executing step inputting
 25 and converting angle information i to the variable X , and executing the cyclic equation in sequence from higher order term to lower order term for the

number of terms of the Taylor series equation to derive a cosine function of the angle information i .

- 5 4. The function arithmetic method according to claim 3, wherein

the cyclic equation executing step includes executing the arithmetic process of the known number Q , the variable X , an intermediate value
10 after the shifting and the constant K of the cyclic equation with the number of bits that is obtained by adding the number of protect bits to the final number of the bits.

- 15 5. A function arithmetic circuit comprising:

a cyclic equation arithmetic unit
calculating a cyclic equation that is obtained by transforming a Taylor series equation for
calculating a sine function, the cyclic equation
20 having a new known number Q that is defined by multiplying a known number Q and the square of a variable X , shifting the result by a shift number S and then adding a constant K thereto;

a conversion adjustment unit converting
25 input angle information i into the variable X , as well as adjusting and outputting the shift number S such that the variable X has a maximum value 1

within a variation range of the variable X;

a constant table finding in advance and
holding constants K corresponding to terms of a
Taylor series equation for calculating a sine
5 function and the shift numbers adjusted such that
the constants K becomes not greater than 1; and

an arithmetic control unit causing the cyclic
equation arithmetic unit to perform a cyclic
arithmetic in sequence, based on the selection of
10 the constant K and the shift number S of the
constant table, from higher order term to lower
order term for the number of terms of the Taylor
series equation defined in advance when the
variable X is output from the conversion
15 adjustment unit, to thereby derive a sine function
of the angle information i.

6. The function arithmetic circuit according to
claim 5, wherein

20 the cyclic equation arithmetic unit executes
the arithmetic process of the known number Q, the
variable X, an intermediate value after the
shifting and the constant K of the cyclic equation
with the number of bits that is obtained by adding
25 the number of protect bits to the final number of
the bits.

7. A function arithmetic circuit comprising:
a cyclic equation arithmetic unit
calculating a cyclic equation that is obtained by
transforming a Taylor series equation for
5 calculating a cosine function, the cyclic
equation having a new known number Q that is
defined by multiplying a known number Q and the
square of a variable X , shifting the result by a
shift number S and then adding a constant K
10 thereto;
a conversion adjustment unit converting
input angle information i into the variable X , as
well as adjusting and outputting the shift number
 S such that the variable X has a maximum value 1
15 within a variation range of the variable X ;
a constant table finding in advance and
holding constants K corresponding to terms of the
Taylor series equation for calculating a cosine
function and the shift numbers adjusted such that
20 the constants K become not greater than 1; and
an arithmetic control unit causing the cyclic
equation arithmetic unit to perform a cyclic
arithmetic in sequence, based on the selection of
the constant K and the shift number S of the
25 constant table, from higher order term to lower
order term for the number of terms of the Taylor
series equation defined in advance when the

variable X is output from the conversion adjustment unit, to thereby derive a cosine function of the angle information i.

- 5 8. The function arithmetic circuit according to claim 7, wherein

 the cyclic equation arithmetic unit executes the arithmetic process of the known number Q, the variable X, an intermediate value after the
10 shifting and the constant K of the cyclic equation with the number of bits that is obtained by adding the number of protect bits to the final number of the bits.

- 15 9. A function arithmetic circuit comprising:

 a pipeline arithmetic unit forming a pipeline connection which includes cyclic equation arithmetic units each provided for each term and calculating a cyclic equation obtained by
20 transforming a Taylor series equation for calculating a sine function, the cyclic equation having a new known number Q that is defined by multiplying a known number Q and the square of a variable X, shifting the result by a shift number
25 S and then adding a constant K thereto;

 a conversion adjustment unit converting input angle information i into the variable X and

adjusting the shift number S such that the variable X has a maximum value 1 within a variation range of the variable X for the output to the pipeline arithmetic unit;

- 5 a constant table finding in advance and holding the constants K corresponding to terms of the Taylor series equation for calculating a sine function and the shift numbers adjusted such that the constants K become not greater than 1; and
- 10 a pipeline control unit causing the cyclic equation arithmetic units of the pipeline arithmetic unit to select the constant K and the shift number S of the corresponding term of the Taylor series equation from the constant table,
- 15 to calculate in parallel and to derive a sine function of the angle information i based on the output of the cyclic equation arithmetic unit at the final stage, each time the variable X is output from the conversion adjustment unit.

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10. The function arithmetic circuit according to claim 9, wherein

- the cyclic equation arithmetic units of the pipeline arithmetic unit execute the arithmetic
- 25 process of the known number Q , the variable X , an intermediate value after the shifting and the constant K of the cyclic equation with the number

of bits that is obtained by adding the number of protect bits to the final number of the bits.

11. A function arithmetic circuit comprising:

5 a pipeline arithmetic unit forming a pipeline connection which includes cyclic equation arithmetic units each provided for each term and calculating a cyclic equation obtained by transforming a Taylor series equation for
10 calculating a cosine function, the cyclic equation having a new known number Q that is defined by multiplying a known number Q and the square of a variable X , shifting the result by a shift number S and then adding a constant K
15 thereto;

 a conversion adjustment unit converting input angle information i into the variable X and adjusting the shift number S such that the variable X has a maximum value 1 within a variation
20 range of the variable X for the output to the pipeline arithmetic unit;

 a constant table finding in advance and holding the constants K corresponding to terms of the Taylor series equation for calculating a
25 cosine function and the shift numbers adjusted such that the constants K become not greater than 1; and

a pipeline control unit causing the cyclic equation arithmetic units of the pipeline arithmetic unit to select the constant K and the shift number S of the corresponding term of the Taylor series equation from the constant table, to calculate in parallel and to derive a cosine function of the angle information i based on the output of the cyclic equation arithmetic unit at the final stage, each time the variable X is output from the conversion adjustment unit.

12. The function arithmetic circuit according to claim 11, wherein

the cyclic equation arithmetic units of the pipeline arithmetic unit execute the arithmetic process of the known number Q, the variable X, an intermediate value after the shifting and the constant K of the cyclic equation with the number of bits that is obtained by adding the number of protect bits to the final number of the bits.

13. A function arithmetic circuit comprising a sine function arithmetic circuit and a cosine function arithmetic circuit,

the sine function arithmetic circuit including:

a pipeline arithmetic unit forming a pipeline

connection which includes cyclic equation arithmetic units each provided for each term and calculating a cyclic equation obtained by transforming a Taylor series equation for

5 calculating a sine function, the cyclic equation having a new known number Q that is defined by multiplying a known number Q and the square of a variable X , shifting the result by a shift number S and then adding a constant K thereto;

10 a conversion adjustment unit converting input angle information i into the variable X and adjusting the shift number S such that the variable X has a maximum value 1 within a variation range of the variable X for the output to the

15 pipeline arithmetic unit;

a constant table finding in advance and holding the constants K corresponding to terms of the Taylor series equation for calculating a sine function and the shift numbers adjusted such that

20 the constants K become not greater than 1; and

a pipeline control unit causing the cyclic equation arithmetic units of the pipeline arithmetic unit to select the constant K and the shift number S of the corresponding term of the

25 Taylor series equation from the constant table, to calculate in parallel and to derive a sine function of the angle information i based on the

output of the cyclic equation arithmetic unit at the final stage, each time the variable X is output from the conversion adjustment unit, and wherein the cosine function arithmetic circuit

5 including:

a pipeline arithmetic unit forming a pipeline connection which includes cyclic equation arithmetic units each provided for each term and calculating a cyclic equation obtained by
10 transforming a Taylor series equation for calculating a cosine function, the cyclic equation having a new known number Q that is defined by multiplying a known number Q and the square of a variable X , shifting the result by a
15 shift number S and then adding a constant K thereto;

a conversion adjustment unit converting input angle information i into the variable X and adjusting the shift number S such that the
20 variable X has a maximum value 1 within a variation range of the variable X for the output to the pipeline arithmetic unit;

a constant table finding in advance and holding the constants K corresponding to terms of
25 the Taylor series equation for calculating a cosine function and the shift numbers adjusted such that the constants K become not greater than

1; and

a pipeline control unit causing the cyclic equation arithmetic units of the pipeline arithmetic unit to select the constant K and the shift number S of the corresponding term of the Taylor series equation from the constant table, to calculate in parallel and to derive a cosine function of the angle information i based on the output of the cyclic equation arithmetic unit at the final stage, each time the variable X is output from the conversion adjustment unit.

14. The function arithmetic circuit according to claim 13, wherein

the cyclic equation arithmetic units of the pipeline arithmetic unit execute the arithmetic process of the known number Q, the variable X, an intermediate value after the shifting and the constant K of the cyclic equation with the number of bits that is obtained by adding the number of protect bits to the final number of the bits.

15. The function arithmetic circuit according to claim 13, wherein

twist coefficient values of a plurality of butterfly stages provided in a pipeline fast Fourier transform apparatus whose radix is 2 are

calculated based on the sine function and cosine function of the input information i.

16. A function arithmetic method comprising:

5 a cyclic equation setting step transforming
and setting a Taylor series equation for
calculating a transcendental function into a
single cyclic equation common to terms of the
Taylor series equation, the cyclic equation
10 having a new known number Q that is defined by
multiplying a known number Q and a variable X,
shifting the result by a shift number S and then
adding a constant K thereto;

an adjustment step adjusting and preparing
15 the shift number S such that within a variation
range of the variable X the variable X has a
maximum value 1 with the constant K being not
greater than 1; and

a cyclic equation executing step converting
20 input information to the variable X and executing
the cyclic equation in sequence from higher order
term to lower order term for the number of terms
of the Taylor series equation to thereby derive
a transcendental function of the input
25 information.